

Diesel Soot Filter Technology Improved

Background

Industrial Ceramic Solutions, LLC, (ICS) of Knoxville, Tennessee, is in the final stages of product development of a ceramic fiber diesel particulate exhaust filter for diesel engine particulate emissions control. A significant part of this development has been sponsored by the U.S. Department of Energy's (DOE) FreedomCAR and Vehicle Technologies Program. Data from diesel engine testing have verified adequate particulate removal efficiency and a number of performance advantages over existing diesel particulate filter (DPF) products. The remaining issues, before commercialization, are soot-loading capacity of the filter cartridge and long-term operating durability on a diesel vehicle.

ICS has conducted vehicle testing to measure soot-loading capacity and filter cartridge durability. These test results indicated that the performance of the ICS filter was slightly poorer than the competition. In order to achieve the significant performance advantages required to enter the DPF market with a superior product, ICS needed to look "inside" the microscopic fiber filter media matrix to understand the integrity of the fiber binder system and the manner in which the soot particles were being trapped in the media.

The Technology

ICS visited the High Temperature Materials Laboratory (HTML), with funding from the Technical Assistance

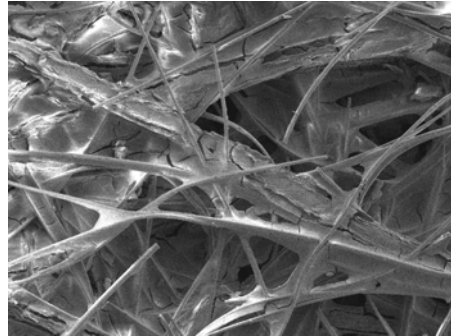


Figure 1. Cracks in filter matrix

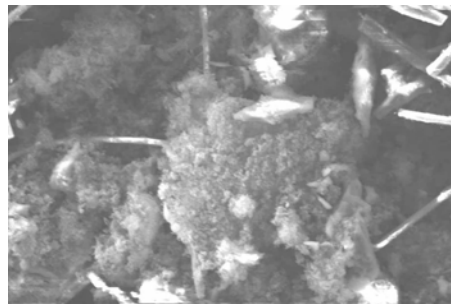


Figure 2. Large trapped soot particles

Benefits

- A small business gained technical data, which would not have been feasible without the DOE's HTML.
- The HTML SEM data initiated breakthrough improvements in the ICS DPF that let ICS become competitive in soot-loading capacity and durability.
- An innovation in diesel emissions control moved from the idea stage to a high-performance commercial product, benefiting diesel engine manufacturers and vehicle original equipment manufacturers.

Program for Small Business. Scanning electron microscopy (SEM) was conducted on diesel exhaust loaded filter media samples under the supervision of Dr. Larry Allard.

An analysis of the SEM images revealed two previously unknown issues that became keys to major future improvements in the ICS filter cartridge performance.

Significant cracking was observed in the fiber binder system that has since been traced to the fabrication process, not the vehicle exhaust stresses. This is shown in Figure 1. ICS was able to change the fabrication process to eliminate the cracking, achieving a 200% increase in filter media strength.

Figure 2 illustrates that soot-loading capacity was being limited by large particles blocking fine pores on the surface of the filter media. Adjustments were made to enlarge the pore size of the entry surface of the media to allow small particles to pass through to the finer porosity to increase soot capacity by 100%.

Commercialization

The information obtained from the HTML SEM work will allow ICS to manufacture a competitive product to compete in the worldwide diesel particulate filter market. The soot-loading capacity and long-term durability are now equivalent to the products on the market.

This will allow ICS to capitalize on its unique performance advantages of lower exhaust backpressure for improved fuel economy; lower thermal mass that reduces the required regeneration energy required, again improving fuel economy; and lower product costs due to simple manufacturing processes.

As a direct function of this work and the subsequent improvements to the ICS DPF cartridge, ICS can now begin supplying test prototypes to worldwide diesel industry users. Success in the customer verification testing will lead to future sales of the ICS diesel particulate filter cartridge into the 2007 markets and beyond.



Where Can I Find More Information?

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